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Periodontal Disease: Breaking the Downward Spiral of the Disease Process

Abstract: Periodontal disease is a common disease affecting more than 50% of the world's adult population. It presents a diagnostic and treatment challenge for the dental clinician. A successful treatment outcome can be achieved by early and repeated intervention when signs of disease are evident in the mouth. Gingival bleeding is one of the early signs of gum disease and one which should not be overlooked by the patient or his/her dental care professional. This is usually indicative of the presence of gingivitis, which can lead to periodontitis in susceptible patients.

CPD/Clinical Relevance: A high standard of plaque control is essential throughout treatment for a favourable periodontal outcome and yet it is unfortunate that sometimes, despite the best endeavour of both patients and clinicians, this is not possible. As a consequence of the failure to establish high levels of plaque control, some patients do not respond fully to traditional periodontal therapy and, for some patients, an ongoing deterioration or 'downward spiral' continues and adjuncts to non-surgical periodontal therapy are indicated to improve periodontal outcomes.

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Periodontal disease is a common disease affecting more than 50% of the world's adult population. It presents a diagnostic and treatment challenge for the dental clinician. A successful treatment outcome can be achieved by early and repeated intervention when signs of disease are evident in the mouth. Gingival bleeding is one of the early signs of gum disease, one which should not be overlooked by patients or their dentist/care professionals. This is usually indicative of the presence of gingivitis, which can lead to periodontitis in susceptible patients. A high standard of plaque control is essential throughout treatment for a favourable periodontal outcome and yet it is unfortunate that sometimes, despite the best endeavour of both patients and clinicians, this is not possible. As a consequence of the failure to establish high levels of plaque control, some patients do not respond fully to traditional periodontal therapy and, for some patients, an ongoing deterioration or 'downward spiral' continues and adjuncts to non-surgical periodontal therapy are indicated to improve periodontal outcomes.

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Periodontitis affects more than 50% of the adult population worldwide.[1] It is a ubiquitous disease, with severe forms affecting 11.2% of adults.[2] Such are the numbers of individuals involved, clinicians should be well versed in determining the ideal periodontal management strategy for each patient under their care. Clinicians should have a clear understanding of key aetiological elements in the complex pathogenesis of periodontal diseases.

A detailed appraisal of the pathogenesis of periodontal disease is outwith the scope of this article, however, it is necessary to recap a few key points. Briefly, periodontal disease is not an infection in the classical sense as, with most infections, a single infective organism causes the disease (eg HIV, syphilis, tuberculosis), and the identification of that organism provides the basis for the diagnosis. In periodontal disease, however, a large number of bacterial species have been identified within the dental plaque biofilm[3] and, as microbiological techniques advance, further organisms are being identified through significant research efforts. The biofilm is composed of microbial cells encased within a matrix of extracellular polymeric substances, including polysaccharides, proteins, and nucleic acids. Dental plaque can be described as an example of a biofilm community and the process of plaque formation can be divided

into several phases:

1. Formation of the pellicle on the tooth surface;
2. Initial adhesion/attachment of bacteria;
3. Colonization/plaque maturation.

During the first 24 hours when starting with a clean tooth surface, plaque growth is negligible from a clinical viewpoint (ie <3% coverage of the tooth surface, which is undetectable clinically). During the following 3 days when plaque is allowed to develop, coverage progresses rapidly to the point at which, after 4 days, an average of 30% of the total coronal tooth area will be covered with plaque.[4] The microbial composition of the dental plaque will change, with a shift towards a more anaerobic and a more gram-negative flora.[4] This generic outline holds true for many patients, although the rate of plaque formation varies between subjects, with factors like variation within the dentition (wearing a partial denture; defective overhanging restorations; crowding), impact of saliva, patient's age and tooth cleaning playing a role (Figure 1). The presence or absence of systemic risk factors may also have a profound bearing on the ability of patients to maintain their oral condition and influence the periodontal treatment outcomes.[5] Given the impact of systemic diseases (such as uncontrolled diabetes and obesity) upon the periodontal tissues and, conversely, the potential benefits of improving periodontal health upon general health (such as the positive effects of periodontal therapy on diabetic/glycaemic control), clinicians more than ever need to have a greater vigilance and pro-activity in their management of patients.

Plaque-induced gingivitis is a reversible disease that occurs when bacterial plaque accumulates at the gingival margin. The prognosis for patients with gingivitis associated with gingival plaque only is good, provided all local irritants are eliminated, other local factors contributing to plaque retention are removed, gingival contours conducive to the preservation of health are attained, and the patient co-operates by maintaining good oral hygiene. If these factors are not addressed, gingivitis may well progress to periodontitis.[6]

There is no doubt that the periodontal bacteria within the plaque biofilm are important in their own right, but the interaction of this complex biofilm with the patient as a host is key in terms of overall outcome. Given the importance of these interactions in periodontal disease, significant research efforts target both the microbiology, and the subsequent host response. In this manner, potential preventive or interventional strategies might be developed in the future.

This paper has its context in the common clinical scenario of patients who fail to respond to conventional periodontal treatment. The reasons for a deteriorating periodontal condition, despite the efforts of patients and clinicians alike, are wide ranging and numerous, however, fundamental to clinicians should be an awareness that oral plaque biofilm disruption is the most effective way to treat and prevent gingival and periodontal conditions.[7] The plaque biofilm disruption may be via the daily oral hygiene practices conducted by the patient and, where necessary, through clinician-delivered treatment on a regular basis. Three monthly mechanical debridement, with manual or power-driven instruments, has been shown to interrupt the re-establishment of harmful biofilm effectively in the periodontium,[7] although this intervention for some is an attempt to overcome an issue of the patient

Figure 1. (a) View of the anterior dentition of a patient at presentation and **(b)** after the use of a disclosing tablet to assess the presence of dental plaque visually for clinical records and patient education. Note the distribution of plaque deposits which are primarily, but not exclusively, interproximal.

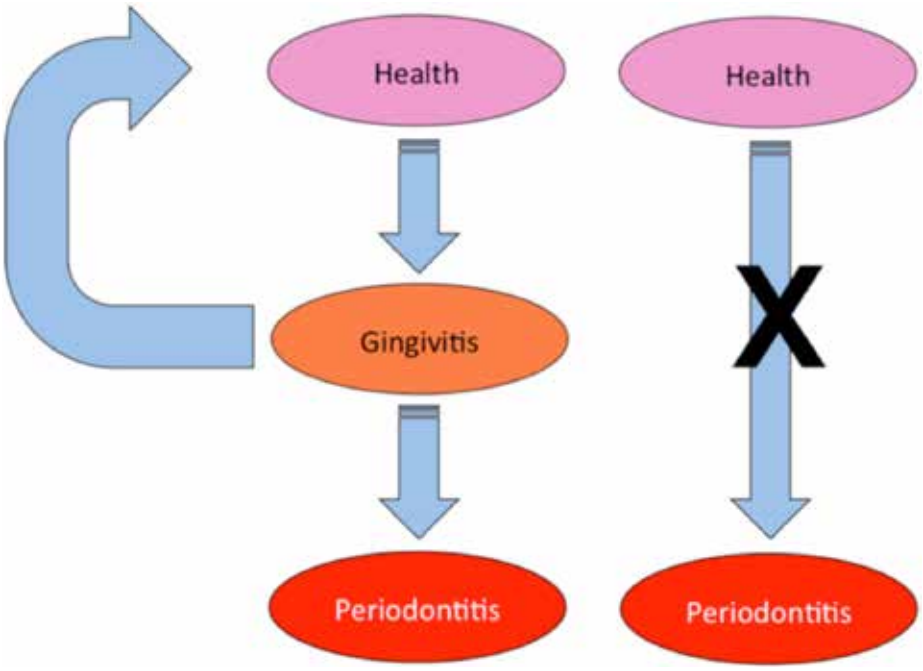

Figure 2. Image highlighting that patients that develop periodontitis will have had a preceding gingivitis and not developed periodontitis *de novo*. Patients who develop gingivitis may remain in that state, or hopefully return to health with management by a dental healthcare professional, or deteriorate further and develop periodontitis.

failing to maintain good plaque control. Unfortunately, most patients are not skilled in effective mechanical plaque removal, ie brushing and interdental cleaning.[8,9] and yet this would be optimal regarding the prevention and management of gingivitis and periodontitis.

Periodontal management – treating gingivitis?

As our knowledge of periodontal pathogenesis has evolved over the years, treatment philosophies have similarly changed. For example, it is now widely accepted that gingivitis and periodontitis are a continuum of the same inflammatory disease.[6] This represents a change in ethos regarding periodontal disease management, particularly amongst primary care practitioners. Prior to this understanding, many practitioners viewed gingivitis as a minor entity that would be desirable rather than essential to manage; if a patient's gingivitis treatment outcome was sub-optimal, this was perhaps deemed of minimal concern. It is now clear that, whilst not all patients with gingivitis will go on to develop periodontitis, those patients who do develop periodontitis will have had preceding gingivitis (Figure 2). The prevention and management of gingivitis is internationally recognized as the primary preventive and treatment strategy of periodontal disease.[10] Given that we are currently unable to predict those patients in whom periodontitis will develop, we should conclude that treating patients with gingivitis is a sensible strategy. The preventive ethos of channelling efforts into the management of reversible gingivitis rather than irreversible periodontitis is further supported by a clinician's inability to predict the precise moment that gingivitis becomes periodontitis. As a consequence, clinicians should be treating gingivitis cases as well as periodontitis cases but, whether funding of clinicians in the public sector incentivizes this preventive approach is an entirely different discussion.

Periodontal management – traditional management

The core guidance for the treatment of gingivitis and periodontitis is essentially the same, with a greater depth of sub-gingival biofilm disruption required for periodontitis. The effectiveness of periodontal therapy in the management of gingivitis is made possible by the remarkable healing capacity of the periodontal tissues. Effective oral hygiene supported by periodontal therapy can reverse chronic gingivitis so that, from a clinical and structural point of view, it is almost identical with gingiva that has never been exposed to excessive plaque accumulation.[11] The same may not be applied to periodontitis where attachment loss is predominantly irreversible. Whilst the healing response to non-surgical periodontal therapy can include attachment gain, and surgical regenerative procedures aim to restore the tissues to their pre-disease architecture, the majority of periodontitis treatment outcomes are founded on the acceptance of a halt to the disease process rather than a full restoration of the tissues already lost.

In terms of the patient journey for the management of periodontitis, once a diagnosis and the prognosis for teeth have been established, the treatment options are discussed with the patient and a definitive treatment plan is composed. The plan should encompass short- and long-term goals and, within this restorative challenge, define a periodontal strategy in the context of a wider restorative vision. Short-term goals would include the elimination of all infections and inflammatory processes that cause periodontal and dental pain and other oral problems that may hinder the patient's general health. The long-term goals are the reconstruction of a healthy dentition that fulfils all functional and aesthetic requirements. Long-term treatment planning may involve the provision of a removable or fixed prosthesis to replace teeth of hopeless periodontal prognosis. The financial impact of long-term treatment needs careful consideration and understanding by the patient. The age and medical health status of the patient must also be considered.

The preferred sequence of periodontal therapy is as follows:

- **Emergency Phase:** This would include the resolution of pain and/or infection alongside the extraction of teeth with hopeless prognosis.
- **Non-surgical phase:** This has several components and includes patient education, such as detailed oral hygiene instruction (the correct use of toothbrushes, interproximal cleaning aids, adjunctive anti-plaque and disclosing agents in order to improve plaque control) as well as smoking cessation advice. This phase of treatment would also include removal of supra- and sub-gingival calculus and disruption of the bacterial plaque biofilm, correction of restorative and prosthetic local plaque-retaining risk factors, the inclusion (or otherwise) of anti-microbial therapies (local or systemic) and occlusal therapy (Figure 3).
- **Surgical phase/restorative phase:** This stage would include the progression from non-surgical therapy to surgical therapy if required, the provision of definitive restorations and fixed/removable prosthodontics appliances.
- **Maintenance phase:** Once periodontal stability has been achieved, there is an ongoing risk of disease recurrence. Therefore the maintenance phase includes the periodic rechecking of plaque and calculus levels and removal/disruption, gingival condition, occlusion/tooth mobility, other pathological changes.

A common theme throughout the treatment phases is disruption of the biofilm which the reader will now gather is the most important principle in periodontal therapy. But what are patients with periodontitis, and clinicians managing them, to expect from treatment and what impact might this have?

The main treatment outcome in the management of periodontitis patients is a reduction in probing depths around individual teeth, but also throughout the mouth. Frustratingly, it is rare for a single phase of non-surgical periodontal therapy to evoke a full response throughout the mouth so that several phases of treatment might be required in order to establish periodontal health. Re-evaluation of success or otherwise, at 3 months following completion of treatment, would ideally see a reduction in pocket depth through a combination of both gingival recession and attachment gain. Healing responses vary widely amongst patients and clinicians vary in their approach. For example, in order to ensure that patients develop a sense of their role in the management of the disease (self-efficacy), clinicians may

delay debridement until plaque control is optimal and the effects of improved plaque control can be seen. This delay needs to be carefully communicated to patients so that they understand the strategy and there is some merit in the approach from a clinical outcome perspective. This strategy ensures that the patient's role becomes well defined and, indeed, patients may well benefit from reduced levels of debridement as pockets will have resolved. However, the anecdotal view from the authors would suggest that this approach is not widespread and that non-surgical periodontal treatment is often performed en-masse in primary care settings.

As a consequence of these different management approaches, the research data requires careful interpretation. The often-quoted seminal Badersten papers demonstrate that improved oral hygiene alone can reduce pocket depths by 0.4–0.5 mm in as little as 3 months,[12] and instrumentation further improves pocket depths (eg by 1.9 mm at 12 months[13]). The deepest pockets tend to show the biggest reduction in pocket depth, and the largest attachment gain. However, this study was carried out on single-rooted teeth only. Plaque removal and the maintenance of lower plaque scores may be more difficult for certain patients and clinicians on multi-rooted teeth. For example, patients with limited manual dexterity or impaired vision may find it close to impossible to remove plaque from the furcation area of an upper second molar. Furthermore, it is a clinician's responsibility to ensure use of the correct and appropriate instruments when performing non-surgical periodontal therapy. These factors should be considered when re-evaluating the success or otherwise of periodontal treatment and care so as not to undermine improvements in periodontal status by clinicians focusing on unresolved problems.

As the tissues heal with successful therapy, the treating clinician must be responsive to changes in the periodontal tissues. The dimensional changes described above have significant impact upon the patient's oral hygiene regimen (Figure 4). For example, where an interproximal periodontal pocket resolves primarily through recession to provide a larger interproximal space, a larger interproximal brush is likely to be warranted. As a consequence, the oral hygiene advice provided will need ongoing titration against the changing clinical scenario. For example, an interproximal space for a 0.4 mm-sized interdental brush advocated at the start of treatment may well be a 0.5 mm after a non-surgical phase of treatment.

The clinician's role

The role of the clinician in the management of periodontal disease is multi-factorial. Within this role, clinicians must not only correctly assess the periodontal tissues and make a diagnosis, they must provide appropriate treatment options consistent with the extent and distribution of the teeth affected, provide a definitive treatment plan and deliver this whilst communicating it to members of the dental team, deliver the treatment and review the success (or otherwise) of treatment. This, in the context of a holistic approach to the long-term oral health of the patient, would seem a huge undertaking in itself. However, in addition to all of these undertakings, the clinician has the unenviable task of trying to ensure that patients fufil their side of the bargain.

Patient compliance with oral hygiene protocols to improve plaque control, and thereby improve periodontal treatment outcomes, is a pre-requisite and even those clinicians with minimal experience will have learned at an early stage that persuading patients to undertake change is difficult. In recent times the term patient adherence has been used to replace the term compliance in an attempt to ensure that patients are not simply complying with what they have been told to do, but rather adhere/stick to a mutually agreed plan between patient and clinician. Therefore, in an ideal world, a patient's behaviour should match the agreed recommendations made between him/herself and the prescriber and should be clear, concise and consistent throughout the practice. It is of little value to the patient if clinician A recommends a product or technique, but clinician B contradicts the advice and recommends product/technique B. If product B is cheaper or easier to use than product A, then the patient will likely select product B or else decide that, if two clinicians can't be clear, then indifference will take over and no product will be used.

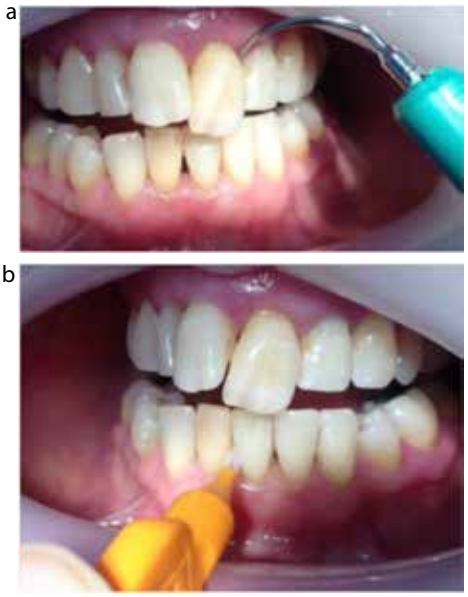

Figure 3. Dental plaque biofilm disruption with **(a)** an ultrasonic scaler and **(b)** an inter-dental brush. A reminder to clinician and patient alike that they both have roles and responsibilities in the management of periodontal diseases.

Figure 4. The dimensional changes that occur **(a)** before and **(b)** after scaling/debridement with further dimensional changes likely following a healing period. The clinician will have to ensure that patients are instructed to use a larger inter-dental brush between the lower incisors.

The traditional approach to oral health intervention has been a curative-restorative approach through instruction and the administration of pamphlets or

Figure 5. A range of oral hygiene products including mechanical devices as well as adjunctive products and patient educational props/models.

information leaflets. There have been a rising number of interventions that aim to change behaviours using approaches from the field of psychology.[14] A popular approach in recent years that is proving to be a promising prospect in creating lasting change and improvement in health interventions is a technique called 'Motivational Interviewing' (MI). MI was defined by Miller and Rollnick[15] as a technique based on evidence, centred on the individual, and individually tailored. The focus of the approach is preparing the individual for change by promoting and facilitating resolution of the ambivalence of individual decisions about how to change and proceed.[15] MI involves three types of communication: direct, guide and monitor; plus three skills: ask, inform and listen.[16] It is not a technique to get patients to do what they do not want to do, rather evoke their motivations to make changes in behaviours for their health.[17] The effectiveness of the MI approach for more lasting behaviour change with consequent improvement in health outcomes has been documented in several systematic reviews related to smoking,[18] as well as the promotion of physical activity and healthy eating habits.[19] MI is key in changing behaviour with a view to empowering patients to accomplish their own plaque control effectively rather than this being dictated by the clinician. An example of the daily use of MI in general practice would include the use of a simple oral hygiene recommendation to patients, introducing only one technique at a time, and waiting until they demonstrate a degree of efficiency in that technique before progressing.

Clearly, clinician recommendations may evolve with time, as periodontal treatment is rarely completed in one treatment or treatment phase, and periodontal treatment involves longitudinal patient care, but at any one point in time with the department/practice there should be consistency. Furthermore, adherence to clinician recommendations in the longer term is also key.

The importance of repeated dental interventions in periodontal management has been well documented for both children and adults. A classical study,[20] which looks at supervised oral hygiene in children, shows that, in patients aged 12–13, supervised daily brushing results in improved plaque control and reduced gingival inflammation. One year later the same cohort of patients showed no improvement over the control group when supervision was not employed.[21]

The positive effects of repeated dental intervention has also been shown in adult patients. Repeated oral hygiene education and oral prophylaxis reduces plaque, gingivitis and attachment loss.[10] Those patients who did not receive reinforcement of oral hygiene instruction and oral prophylaxis were shown to have more than three times the level of attachment loss; a clear demonstration of the importance of ongoing patient care and clinician involvement. The consequences of tooth loss due to periodontal disease are great. Early intervention is recommended to avoid over-eruption or drifting of the remaining teeth. The restoration of an edentulous space with periodontally involved abutment teeth provides an enormous challenge for a clinician, particularly with regard to fixed prosthesis. Careful design of removable and fixed prostheses is crucial to facilitate optimal oral hygiene and patient comfort.

Periodontal management-adjuncts to periodontal therapy

In an ideal world, patients with gingivitis or periodontitis would adhere to our recommendations, receive quality periodontal treatment and the issues that they have would resolve. Of course, as wet-fingered clinicians, we exist in a sub-optimal world where issues conspire to impact upon the ideal treatment outcome and we are left to manage a patient in the best way possible. Problems may sometimes arise when the patient is non-compliant with oral hygiene instruction, or non-adherent to the treatment plan. The reasons for non-compliance are highly variable[22] and include lack of pertinent information, fear, economics and the patient's perception of lack of clinician compassion.

For some patients, periodontal surgery to improve access to the root surface deposits may well be warranted, but many patients are surgically averse and so the clinician may be left with a non-surgical approach that is not producing the required outcomes.

Given the constraints that clinicians operate within, and a patient in whom the periodontal condition is adversely spiralling, it may be necessary to consider adjunctive periodontal

therapies. The key here is adjunctive and not replacement so that conventional periodontal therapies are not abandoned but provided in addition. Indeed, the 2011 consensus report of the European Federation of Periodontology workshop on periodontitis states: 'The use of adjunctive chemical approaches to biofilm control may be considered in support of mechanical plaque removal protocols but it is not a suitable substitute for the latter, or a more time efficient method for effective biofilm control'.[23]

Further, 'when considering adjunctive chemical agents for controlling plaque and/or gingival inflammation it is important that the clinician is aware of the evidence base for such agents, their side effects and any environmental impact'.

Widely available adjuncts to periodontal therapy include mouthrinses, anti-microbials (local and systemic) and also host-modulating drugs, all of which should be used in combination with traditional periodontal debridement (Figure 5). Use of these products alone as a replacement for periodontal debridement should be considered contra-indicated.

Anti-microbial agents (topical or systemic) can be used as an adjunct to conventional, non-surgical periodontal therapy, but should be limited to cases where:

- Patient is unable to practise high levels of plaque control, eg due to difficulties in manual dexterity or disability;
- Mechanical therapy alone may not effectively control infection, particularly in deep pockets;
- Tissue invasive organisms are not eradicated without antibiotic therapy.

A common and widely used, and prescribed, adjunct is mouthwash. There is such a wide array of mouthwashes available to patients it can sometimes be overwhelming when deciding which would be the most effective. Boyle *et al*[24] published a comprehensive systematic review with meta-analysis on both the efficacy and safety of antiseptic and fluoride mouthrinses in January 2014. Mouthrinses were found to benefit the patient in terms of reducing the risk of dental plaque, gingivitis and dental caries. Chlorhexidine mouthwashes were shown to reduce plaque and gingivitis levels significantly as an adjunct to standard care. They have also been shown to have a bactericidal effect on the plaque biofilm.[25] Essential oil mouthrinse was found to be less effective than chlorhexidine mouthwash in the short-term (<3 months), but equalled or exceeded its performance at 6 months.[25] Cetylpyridinium chloride was found also to be effective, but less so than chlorhexidine and essential oil mouthwashes.[25] Of course, mouthrinses are not the periodontal panacea as some have potentially detrimental effects on oral health, such as extrinsic staining which, in the view of the authors, is counterproductive in that the staining is plaque retentive and in an already periodontally susceptible patient should be avoided. Understanding the limitations of self-medication with oral healthcare products without a diagnosis of the underlying condition is crucial, both on the part of the patient and the clinician.

Conclusion

Periodontitis is a common disease, affecting >50% of the adult population worldwide. The key to breaking the periodontal downward spiral is early recognition and intervention. Gingivitis and periodontitis have been shown to be a continuum of the same inflammatory disease, and the focus of attention should be on gingivitis management as well as periodontitis management. The general public should be educated that bleeding gums is an early sign of disease and the oral health team have a responsibility in health promotion and primary and secondary prevention. A consistent oral health message from the entire team is advantageous in establishing good treatment outcomes. Clinicians should also keep up-to-date with new concepts in periodontology and implement them (where possible) in general practice. If periodontal therapy is not achieved by the general dental clinician, despite strict oral hygiene instruction and initial periodontal therapy, referral for a specialist periodontal opinion is recommended.

A high standard of plaque control is essential throughout treatment for a favourable periodontal outcome, and the importance of strict oral hygiene instruction cannot be emphasized enough. Where oral hygiene levels are sub-optimal, or compliance has been poor, adjuncts to mechanical therapy should be considered.

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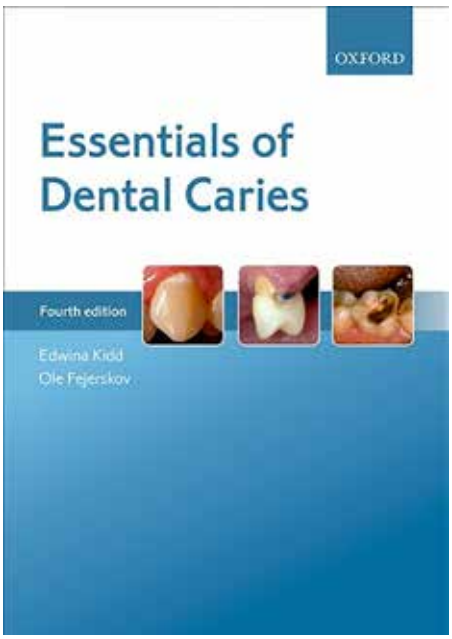
Book Review

Essentials of Dental Caries 4th edn. By Edwina Kidd and Ole Fejerskov. Oxford: Oxford University Press, 2016. (208pp; £29.99 p/b). ISBN: 9780198738268.

It is now nearly 30 years since the first edition of this text book was published by one of the current authors, Edwina Kidd, accompanied at that time (1987) by Sally Joyston Bechal. For this fourth edition she is accompanied by Ole Fejerkov, both undoubted leading academics in the field of Cariology. The original textbook set out to do what it says on the tin, provide the undergraduate dental student with the 'Essentials of Dental Caries' to enable them to bring 'basic theoretical concepts to the chairside' to enable the understanding and 'rationale behind clinical techniques' and caries management. It sounds a bit like the term we have come to know, 'Translational Research' which the Medical Research Council describes as turning fundamental discoveries into improvements in human health and economic benefit and did not really appear in the Medical Literature until the early 1990s, some time after the first edition of this book was published!

Much has changed over the last three decades, both from the knowledge gained through research and clinical practice, together with the recognition and expansion of the oral healthcare team. The fourth edition does remain true to form and is the perfect cariology starting block for 'junior students, dental nurses, oral health educators, hygienists and therapists' and all others involved in oral healthcare. The book consists of eight chapters and is both easy to read and thought provoking. Chapter one, the 'Introduction', like all good books sets the scene and defines what Dental Caries is and describes various *flavours* of the disease. Chapter two expands on this and describes how carious lesions develop from the initial biofilm formation to frank cavitation; it emphasizes the dynamic nature of the disease and the role that bacteria, saliva and diet play. A chapter on caries detection and diagnosis follows focusing on the clinical visual examination and the use of classification systems that assess activity and lesion severity. This chapter also looks at useful and realistic aids to caries detection and diagnosis that can be used to inform the clinician still further. There are three chapters on caries control, the latter word preferred by the authors over prevention, the reasoning being apparent in the text; one for all patients, one for patients with active disease – where the gas has to be turned up – and one for the population. The third edition of this textbook finished with a chapter on 'The operative management of caries', and in this new fourth edition it has changed to 'When should a dentist restore a cavity?' This chapter questions the once aggressive, early and rather extensive restoration of teeth to a philosophy of truly controlling the disease through less invasive biological means. What use is all of this information if it cannot be relayed to the patient in a meaningful way in order to bring about change? The answer would perhaps be none, so there is therefore a chapter on communication, motivation and behaviour change.



The Epilogue to the book is thought provoking and challenges how oral healthcare is provided, by whom and for whom in a cost-effective way. *Essentials of Dental Caries* is a must for all students involved in the delivery of oral healthcare. Not only is it essential reading for those starting off on their career, but it is also a welcome refresher for those that have been at it for some time!

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